

Volume 18: 13–18
Publication date: 20 January 2015
dx.doi.org/10.7751/telopea7935

TELOPEA

Journal of Plant Systematics



plantnet.rbgsyd.nsw.gov.au/Telopea • escholarship.usyd.edu.au/journals/index.php/TEL • ISSN 0312-9764 (Print) • ISSN 2200-4025 (Online)

Aidia gyropetala A.J.Ford & Halford (Rubiaceae), a new and dioecious species from north-east Queensland.

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Abstract

Aidia gyropetala A.J.Ford & Halford is described, illustrated and diagnosed against the two other species in Australia, *Aidia cowleyi* and *A. racemosa*. Notes on habitat, distribution and conservation status are provided. A key to the species of *Aidia* in Australia is presented.

Introduction

Aidia Lour. (Rubiaceae, Gardenieae) is a genus of about 55 shrub, tree and vine species (Govaerts *et al.* 2014) which are distributed throughout Malesia, the western Pacific, the palaeotropics and Africa (Puttock 2001). In Australia *Aidia* has been represented by two tree species, the endemic species *A. cowleyi* Puttock and *A. racemosa* (Cav.) Tirveng. which is very widespread and variable.

Puttock and Quinn (1999) in their assessment of genera within Gardenieae placed emphasis on ovary, carpel, fruit and seed characters, whilst Dawson and Gereau (2010) provide a set of distinguishing features for *Aidia* that together are unique within the Gardenieae. These features include morphology of: stipules, hermaphroditic flower-mery, corolla lobe aestivation, number of ovary locules and a “distinctive inflorescence arrangement”. This arrangement is described as, “inflorescences are congested to laxly cymose and borne on one side of the stem at or just above every second or third node in a pseudoaxillary or supraaxillary position”. Dawson and Gereau (2010) also introduce the use of the term ‘pollen presenter’ rather than stigmatic lobes.

Recently, a number of specimens collected from a very geographically restricted area near Mt Lewis in north-east Queensland have been recognized as belonging to a new species of Rubiaceae. As this new species matches the majority of critical features discussed above by Dawson and Gereau (2010) for inclusion into *Aidia* we describe this species below as *A. gyropetala* A.J.Ford & Halford.

Materials and Methods

The study is based upon the examination of herbarium material from BRI and CNS (previously QRS) with field observations by the first author. All specimens cited have been seen by one or both authors. Measurements of the floral parts and fruits of *Aidia gyropetala* are based on fresh specimens or material preserved in 70% ethanol. Common abbreviations in the specimen citations are: LA (Logging Area), SFR (State Forest Reserve), R (Reserve) and EP (Experimental Plot).

Taxonomic Treatment

Aidia gyropetala A.J.Ford & Halford, *sp. nov.*

Distinguished from *A. racemosa* by the tertiary venation being very inconspicuous (versus conspicuous in *A. racemosa*), flower sexuality (unisexual versus bisexual), hypanthium length (2.9–3.9 mm versus 1–2 mm), corolla lobe length: width ratio (1–1.2 versus 1.6–2.6), corolla lobe habit (erect versus reflexed) and filament length (absent versus 2–3 mm).

Type: Queensland: Cook District: Mt Lewis National Park, [W of Mossman] adjacent to CSIRO EP/18, *A. Ford* 6085 & *W. Cooper*, 26 Sep 2012 (holotype: BRI, isotypes: A, CANB, CNS, HO, K, L, MEL, MO, NSW, SING, Z)

Aidia sp. (Mt Lewis) (Cooper 2004: 433)

Illustrations: Cooper (2004: 433), as *Aidia* sp. (Mt Lewis).

Subcanopy or canopy tree to 19 m high, with stem diameter up to 19 cm (dbh), glabrous, dioecious; bark closely roughened, with numerous narrow horizontal corrugations; wood pale yellow-cream, darkening markedly upon exposure, outer blaze with a conspicuous thin layer with longitudinal stripes and speckles. *Branchlets* \pm terete and longitudinally striated when dry; bark on old twigs pale and with corky appearance, leafy twigs glabrous, flattened slightly at nodes. *Leaves* opposite, petiolate; stipules interpetiolar, sheathing, green when fresh, 2.1–3 mm long, triangular, glabrous, deciduous after first or second node and therefore rarely fragmenting as node thickens; colleters present; petioles 4.5–7 mm long; *lamina* discolorous, leathery and thin, elliptic, 7–12.5 cm long, 2.4–4.7 cm wide; adaxial surface dark green; abaxial surface much paler than adaxial surface; midvein raised on both surfaces, more obvious on abaxial surface, venation brochidodromous with 6–8 lateral veins per side of the midvein; lateral veins raised on abaxial surface and flush to slightly depressed on adaxial surface (in both fresh and dried material); secondary venation sparse and more obvious towards margin; tertiary venation not discernible; base cuneate; margins entire; apex acuminate; pocket domatia with hairs around orifice present on all leaves at the midvein-lateral vein junction, usually near the middle of the blade (rare to absent at proximal and distal ends). *Inflorescence* an axillary, (rarely ramiflorous) paniculate monochasium, 1.6–2.2 cm long, composed of 6–36 flowers, produced only in one axil of a leaf pair and then at every second node, with subulate subtending scale-like leaf or much-reduced leaf and opposing full-sized leaf, distance between flowering and non-flowering nodes 2.5–3.2 cm; primary peduncle 1.5–5 mm long, secondary and later peduncles (sensu Puttock 2001) 2–6 mm long, glabrous, stout; bracts connate, triangular 1–1.2 mm long, apex acuminate with white appressed hairs, rarely extending down to margin, glabrescent; persistent or nearly so. Flowers 5-merous, functionally unisexual although appearing bisexual; pedicel 2–2.5 mm long, glabrous, terete. *Hypanthium* green, 2.9–3.9 mm long, 2 mm across, glabrous, conical to urceolate. Calyx tube 0.8–1.6 mm long, glabrous on both surfaces, margin truncate with or without scattered hyaline hairs; *calyx lobes* minute but conspicuous, triangular, c. 0.2 mm long, with an apical tuft of short white hairs. *Corolla* imbricate, deciduous, \pm funnel-shaped, white at anthesis becoming dull creamish yellow with age, erect (not spreading or reflexed, sensu Ridsdale 1996); tube 3–4.5 mm long, c. 1.9 mm across the throat, glabrous on abaxial surface, bearded adaxially below throat at insertion of stamens, glabrous proximally; hairs white; *corolla lobes* \pm erect, ovate, 3.5–4.2 mm long, 3.4–3.7 mm wide, glabrous. Male flowers: *stamens* included; anthers sessile, inserted at the sinuses of the corolla lobes, dorsifixed, not versatile, adnate in lower half of anther, c. 4.5 mm long, glabrous, apiculate, dehiscing laterally through longitudinal slits. *Ovary* 2-celled; summit pubescent; ovulodes present in the rudimentary ovary. *Style* with non-functional pollen presenter, c. 6 mm long, glabrous, caducous. Female flowers: *staminodes* included; anthers sessile, inserted at the sinuses of the corolla lobes, c. 4 mm long, apiculate, sterile. *Style* c. 4 mm long, deciduous, striated, glabrous; pollen presenter c. 2.6 mm long and c. 0.8 mm wide, anther-like with stigmatic surfaces lateral. *Ovary* 2-celled, 18–24 ovules per locule which are embedded in the placenta. *Fruit* a drupe, ellipsoidal to obovoidal, shiny, glabrous, 11–13(–15) mm long and 7–9(–11) mm diameter, orange when ripe, fruiting pedicels slender 4.1–6 mm long, crowned by persistent calyx tube 0.8–1.6 mm long (which scarcely or doesn't hide the ovary apex); pericarp firm and leathery; mesocarp fleshy, containing 25–40 seeds which are stacked horizontally amongst the placenta. *Seed* triangular, brown, c. 3 mm long, c. 1.3 mm wide, c. 0.8 mm thick; testa corneous;



Fig. 1. *Aidia gyropetala*. **a**, flowering branchlet with male flowers. **b**, flowering branchlet with female flowers. **c**, fruiting branchlet with immature fruit, showing subulate subtending scale-like leaf and pocket domatia on full-sized leaf. **d**, habitat, habit and bark of largest known tree (with Mireia Torello-Raventos).

endosperm corneous, white; embryo c. 1.1 mm long, straight; radicle longer than but narrower than cotyledons. *Specific wood density* 810 kg/m³. *Seedlings* unknown. Fig 1.

Distribution: Endemic to the Wet Tropics bioregion (Department of the Environment 2012) in north-eastern Queensland, Australia, where it is currently only known from the Carbine Tableland (Mt Lewis area), west of Mossman. Fig. 2.

Phenology: Flowers reported in September and ripe fruits reported in February.

Habitat: This species is recorded from the mountainous slopes and high rainfall areas of Mt Lewis in notophyll vine-forests/rainforests on soils derived from granite. Common canopy species include: *Acmena resa*, *Balanops australiana*, *Elaeocarpus elliffii*, *Garcinia zichii*, *Niemeyera* sp. (Mt Lewis), *Planchonella euphlebica*, *Sphalmium racemosum*, *Stenocarpus davallioides* and *Syzygium wesa*. Common small trees and shrubs include: *Apodytes brachystylis*, *Chionanthus axillaris*, *Linospadix apetirolata*, *Oraniopsis appendiculata*, *Pittosporum rubiginosum*, *Polyosma rigidiuscula*, *Polyscias purpurea*, *Psychotria* spp., *Steghanthera maccooraia* and *Wilkiea angustifolia*. Altitudinal range from 1000–1100 m.

Etymology: The epithet *gyropetala*, from the Greek *gyros* (circle or round), and *petalon* (leaf, thin plate) hence petal, in reference to the relative roundness of the corolla lobes of this species.

Affinities: Morphologically *Aidia gyropetala* would appear to be most closely related to *A. racemosa*. A comparison of diagnostic differences between the three *Aidia* species occurring in Australia is provided in Table 1.

Notes: The flowers of *Aidia gyropetala* are recorded as being slightly perfumed. The corolla changes colour from white, once the corolla lobes have fully expanded, to a dull creamish yellow following anthesis. This feature is also recorded in many other Rubiaceae genera which occur in north Queensland rainforests, such as *Cyclophyllum*, *Gardenia*, *Larsenaikia*, *Morinda* and *Tarenna*. The only previously recorded instance of such a colour change in *Aidia* is noted by Ridsdale (1996) who indicates that for the Borneo vine species *A. paiei* Ridsdale the corolla is “said to be white turning yellow”. Recent discussions have also revealed the same colour change occurring in the widespread *A. densiflora* (Wall.) Massam. (Yee Wen Low, pers. com., 2014).

Although flowers of *Aidia gyropetala* appear to be functionally bisexual, they are from the first authors observations functionally unisexual with individual plants having exclusively either male or female flowers. Twelve trees were seen in flower at the type locality, but only one of these trees produced fruit. All flowers

Table 1. Morphological comparison between *Aidia cowleyi*, *A. racemosa* and *A. gyropetala*. Measurements for *A. cowleyi* and *A. racemosa* mostly taken from Puttock (2001).

| | <i>A. cowleyi</i> | <i>A. racemosa</i> | <i>A. gyropetala</i> |
|--------------------------------------|--------------------|-----------------------|-----------------------|
| Tree sexuality | monoecious | monoecious | dioecious |
| Flower sexuality | bisexual | bisexual | unisexual |
| Stipule margin | ciliate | usually ciliate | eciliate |
| Tertiary venation | very inconspicuous | conspicuous | very inconspicuous |
| Hypanthium length (mm) | 1–2 | 1–2 | 2.9–3.9 |
| Calyx tube length (mm) | 1.5–2 | 1–2 | 0.8–1.6 |
| Calyx lobe apex | glabrous | tufts of hair | tufts of hair |
| Corolla tube length (mm) | 1.5–2 | 4–6 | 3–4.5 |
| Corolla lobe habit | reflexed | reflexed | erect |
| Corolla lobe length (mm) | 5–6 | 5–8 | 3.5–4.2 |
| Corolla lobe width (mm) | 2.5–3 | 2–3 | 3.4–3.7 |
| Corolla lobe length: width ratio | 1.6–2.3 | 1.6–2.6 | 1.0–1.2 |
| Filament length (mm) | c. 1 | 2–3 | absent |
| Style + pollen presenter length (mm) | 6–7 | 10–17 | c. 6.6 |
| Pollen presenter length (mm) | 4.5–5 | 5–8 | c. 2.6 |
| Fruit shape | globose | ellipsoidal/obovoidal | ellipsoidal/obovoidal |
| Altitudinal range (m) | sea-level to 700 | sea-level to 550 | 1000–1100 |

examined from the fruiting tree are functionally female, with the anthers being full-sized but sterile (pollen absent). Conversely, only functionally male flowers were observed on the non-fruiting trees. The male flowers have a well developed style and pollen presenter and an ovary which appears to possess ovules within a placental mass. However, the style is caducous and the ‘ovules’ are much reduced compared to the functionally female flowers. These observations of male flowers with ovules and female flowers with anthers are also recorded for species within *Atractocarpus* (Puttock 1999). Furthermore, there are more flowers per inflorescence in male trees than in female trees. It appears as though *Aidia gyropetala* is dioecious. Previously, *Aidia* is recorded as being monoecious, polygamodioecious and andromonoecious (Puttock 2001). Such variation in reproductive strategy within a genus has been reported in the allied *Atractocarpus* (Puttock 1999), so it is not extraordinary in the Gardenieae.

The erect corolla lobes of *Aidia gyropetala* are an uncommon character state in *Aidia*. Ridsdale (1996) reports that of all the shrub and tree species of *Aidia* in Malesia and South-East Asia only one species, *A. congesta* (Schltr. & K.Krause) Ridsdale from New Caledonia, has corolla lobes that are “apparently not reflexed”. All other shrub and tree species have corolla lobes which are strongly reflexed, including *A. cowleyi* and *A. racemosa*. If all taxa of *Aidia* are considered in Ridsdale (1996), there are 28 with reflexed corolla lobes (17 tree species and 11 vine species), five with erect/not reflexed corolla lobes (one tree and four species of vines) and 16 with no assignment of corolla lobe habit.

Conservation Status: All existing collections of *Aidia gyropetala* have been made from a single population within the Mt Lewis National Park, west of Mossman which is part of the World Heritage Area of the Wet Tropics bioregion (Department of the Environment 2012). The species’ known geographical range is very narrow with an extent of occurrence estimated to be less than 4 km² and an area of occupancy estimated to be less than 1 km². The size of the single population is not known, but an optimistic estimate of less than 300 mature individuals is not considered extravagant. The restricted distribution of the species makes it prone to stochastic events which may reduce the population or eliminate it. This species requires an accurate survey to determine the geographical range and gain a better understanding of the population size and structure. Currently there are no substantiated threatening processes; however, processes that may present a potential threat to this species are genetic inbreeding depression as a result of the small population size and global warming which may reduce the ecological fitness of the species. We would recommend *A. gyropetala* being listed as “Vulnerable” under the IUCN (2012) as it fulfills the criteria under categories VU, D1 and D2.

Other specimens examined: Queensland: Cook (Anonymous 1975): Mt Lewis National Park, adjacent to CSIRO EP/18, Ford 5834, 18 Apr 2011 (BRI, CNS, L, MEL, MO, NSW, Z); *loc. cit.*, Ford 6085 & Cooper, 26 Sep 2012 (BRI, CNS); *loc. cit.*, Ford 6105 & Cooper, 21 Dec 2012 (BRI, CANB, CNS, L, MEL, MO, NSW, NY, SING); *loc. cit.*, 14 km from the gate, Ford 6267 & Cooper, 13 Sep 2013 (BRI, CNS); SFR 143, Parish of Riflemead, North Mary LA, Gray 4565, 21 Aug 1987 (CNS); Mt Lewis National Park, a little west of CSIRO EP/18, Ford 6081, 6 Sep 2012 (BRI, CNS); Mt Lewis next to CSIRO plot, Jensen 1235, 14 Feb 2002 (CNS); Exp. E/P 18 North Mary LA, R. 143 Mt Lewis, Sanderson 427, 17 Sep 1973 (CNS); Mt Lewis National Park, CSIRO EP/18, 14 km from the gate, Ford 6268 & Cooper, 13 Sep 2013 (BRI, CNS); *loc. cit.*, Ford 6293 & Torello-Raventos, 31 Jan 2014 (BRI, CNS, L).

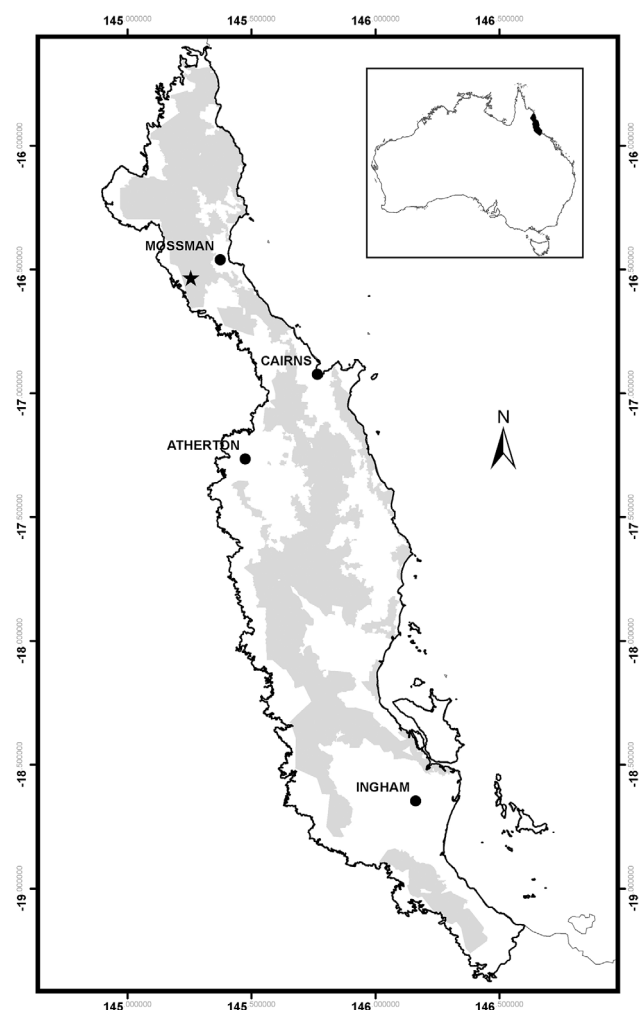


Fig. 2. Distribution of *Aidia gyropetala* (★) in north-east Queensland. Shaded areas represent the Wet Tropics World Heritage Area within the Wet Tropics Bioregion.

Key to the species of *Aidia* in Australia

- 1a. Hypanthium 2.9–3.9 mm long; staminal filaments absent; corolla lobe length to width ratio 1–1.2 *A. gyropetala*
- 1b. Hypanthium 1–2 mm long; staminal filaments present; corolla lobe length to width ratio 1.6–2.6 2
- 2a. Calyx lobe apex glabrous; corolla tube 1.5–2 mm long; fruit globose-spherical *A. cowleyi*
- 2b. Calyx lobe apex with hairy tufts; corolla tube 4–6 mm long; fruit ellipsoidal/obovoidal *A. racemosa*

Acknowledgments

This research was facilitated by the *Long Term Ecological Research Network, Australia* (LTERN). LTERN is a facility within the *Terrestrial Ecosystem Research Network* (TERN). TERN is supported by the Australian Government through the *National Collaborative Research Infrastructure Strategy*. Permits to collect in the “Wet Tropics” were issued by the Department of Science, Information Technology, Innovation and the Arts and the Queensland Parks and Wildlife Service. Wendy Cooper and Mireia Torello-Raventos provided great company on the several trips to Mt Lewis to secure specimens. Lyn Craven (then CANB) and Elizabeth Minchin (ANU) shed light on the appropriateness and correct use of the species epithet. Seonaid Philip provided GIS assistance for the distribution map. Thanks also to an anonymous reviewer who markedly improved the manuscript. The curators and staff at BRI and CNS are thanked for allowing access to specimens and the use of their facilities.

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Manuscript received 19 September 2014, accepted 12 December 2014